Serial No.: 10/042,878
Filing Date: January 9, 2002

Remarks

The Examiner has rejected claims 1-12, 14 and 16-26, and allowed claim13 if rewritten.

The Examiner has rejected Claims 1-8 and 16-23 of the present application under 35USC103(a) as being unpatentable over Hause (US 6090694) in view of Brown (US 5882967), Meador (US 5919599) and Hyakutake (US 6087250 (corrected by Applicant)). Claims 9-11 have been rejected under 35 USC 103(a) as being unpatentable over Hause in view of Brown, Meador and Hyakutake as applied to claim 1, and further in view of Puligadda (US 6,323,310). Claim 12 is under 35 USC 103(a) as being unpatentable over Hause in view of Brown, Meador and Hyakutake as applied to claim 1, and further in view of Diachiara (US 5482817). Claim 14 have been rejected under 35 USC 103(a) as being unpatentable over Hause in view of Brown, Meador and Hyakutake as applied to claim 1, and further in view of Samuels (US 6268907). Claims 24 and 26 have been rejected under 35 USC 103(a) as being unpatentable over Hause in view of Brown, Meador and Hyakutake as applied to claim 1, and further in view of Malik (US 6312870). Claim 25 have been rejected under 35 USC 103(a) as being unpatentable over Hause in view of Brown, Meador and Hyakutake as applied to claim 1, and further in view of Yoon (US 6,537,727).

The Examiner has objected to claim 13 as being based upon a rejected base claim, but would be allowable if rewritten in independent form.

In a telephonic interview with the Examiner on June 17, 2005 at 10:30am, the rejection issued by the Examiner was discussed. At the interview, the inventor, Dr. Mark Neisser, was also present. The arguments presented to the Examiner at that time are summarized below. Reference was made to Figures 2-4 in the specification and no new matter is being added.

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The present invention, and claim 1, discloses a bottom antireflective coating which is a radiation sensitive developer soluble **organic** coating. A radiation sensitive antireflective coating (ARC) is unique in that it comprises a polymer which interacts with a photogenerated acid such that the bottom antireflective coating is developable in the same step (step (d)) as the photoresist. Both the antireflective coating and the photoresist are developable in an aqueous alkaline developer. Since the development process of the ARC is dependent on light interactions to generate deprotection of the polymer to make it developer soluble, if a node (destructive interference so that no light is present) of the standing wave is present within the antireflective coating, then the bottom antireflective coating will not develop. Thus, for developer soluble bottom antireflective coating (DBARC), the determination of the maximum thickness of the bottom antireflective coating (BARC) is critical to avoid the presence of the node.

Hause discloses the concept of an antireflective coating which can be removed by a developer. However, there are no constructive examples or chemistries described in the patent, so Hause could not have possibly foreseen problems associated with the development of the ARC. House assumes that standard principles of selecting film thickness of the ARC would apply, and does not suggest any methodology for selecting the ARC film thickness.

Hayutake does not teach the concept of developer soluble BARC or even organic BARC. Hayutake only teaches the use of an **inorganic** BARC, especiallyTiN, which is based on only optical parameters and where the coating is removed by dry etching and not wet development. This patent mentions in column 3, lines 16-19, that the film thickness of the inorganic BARC depends on the wavelength of the light source. There is no understanding or anticipation of the parameters and issues necessary for the development of the DBARC by the interaction of light with the development of the DBARC polymer. Hayutake is

based on a totally different concept of the ARC from Hause. Thus the applicants argue that Hause cannot be combined with Hayutake.

Neither Hause nor Hayutake foresee the problem of light interaction in the DBARC film that the present application must solve.

The state of the art prior to the present application was to determine the desirable film thickness for a BARC by plotting the swing curve, as shown in Figure 2 of the present patent application. As explained in the specification, for a developer soluble BARC, the DBARC system cannot be very highly absorbing since then light would not get through the DBARC film to the substrate. Thus for a lower absorbing BARC film, the plot on the right of Figure 2 relating to a lower absorbing polymer is used to determine the minimum reflectivity. One of ordinary skill in the art would determine that the optimum BARC film thickness is obtained at minimum reflectivity by working at the second minimum, around 0.09 microns. However, as explained on page 19, lines 25-35, when this optimum thickness at the second minimum was used, poor lithographic performance was obtained. Surprisingly and unexpectedly, when the first minimum DBARC film thickness was used a better result was obtained, contrary to fig. 2 (right). Upon conducting simulation of the light distribution of the latent image in the BARC, a node of destructive interference was discovered as seen in Fig. 3. A node is where no light or very little light is present, regardless of the exposure dose. Since there is not sufficient light at the node, development stops at the node because the polymer is not sufficiently deprotected to make the polymer soluble in an alkali developer, resulting in scumming. Figure 4 shows the development profile of the DBARC when the film thickness of the DBARC is at the first minimum, no node is present and the development is clean. Contrary to common understanding, where for inorganic or non developer soluble BARCs the film thickness chosen is where minimum reflectivity is present in a swing curve, for DBARC, where light interference plays a critical role, a film thickness where less light may be

absorbed but a node is not formed is preferred. Thus the maximum film thickness of the DBARC has to be where a node is not formed. The position of the node in the BARC film is determined by $\frac{\lambda}{2n}$, wherein λ is the wavelength of the actinic radiation of step (c) and n is the refractive index of the B.A.R.C. composition.

The applicants have solved a problem present for the DBARC which the prior art did not encounter and could not have foreseen. The applicants have clearly explained the rationale and the necessity for the limitation in claim 1 where the maximum film thickness of the DBARC has to be $\frac{\lambda}{2n}$ to avoid the presence of a node in the DBARC.

In view of the above explanation and remarks, the present application is believed to be in condition for allowance, and reconsideration of it is requested. If the Examiner disagrees, she is requested to contact the agent for Applicants at the telephone number provided below.

Respectfully submitted,

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